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ABSTRACT

To determine the effects of hearing impairment on school performance of students for whom no special educational provisions had been made, 116 students (ages 7 through 17 in public school grades 2 through 10) were evaluated for auditory impairment, IQ, and educational achievement. Findings of the study showed that even mild hearing impairment resulted in educational retardation. The study also indicated the need for early and improved screening for auditory handicaps, and the lack of educational provisions for the mildly impaired. (PD)

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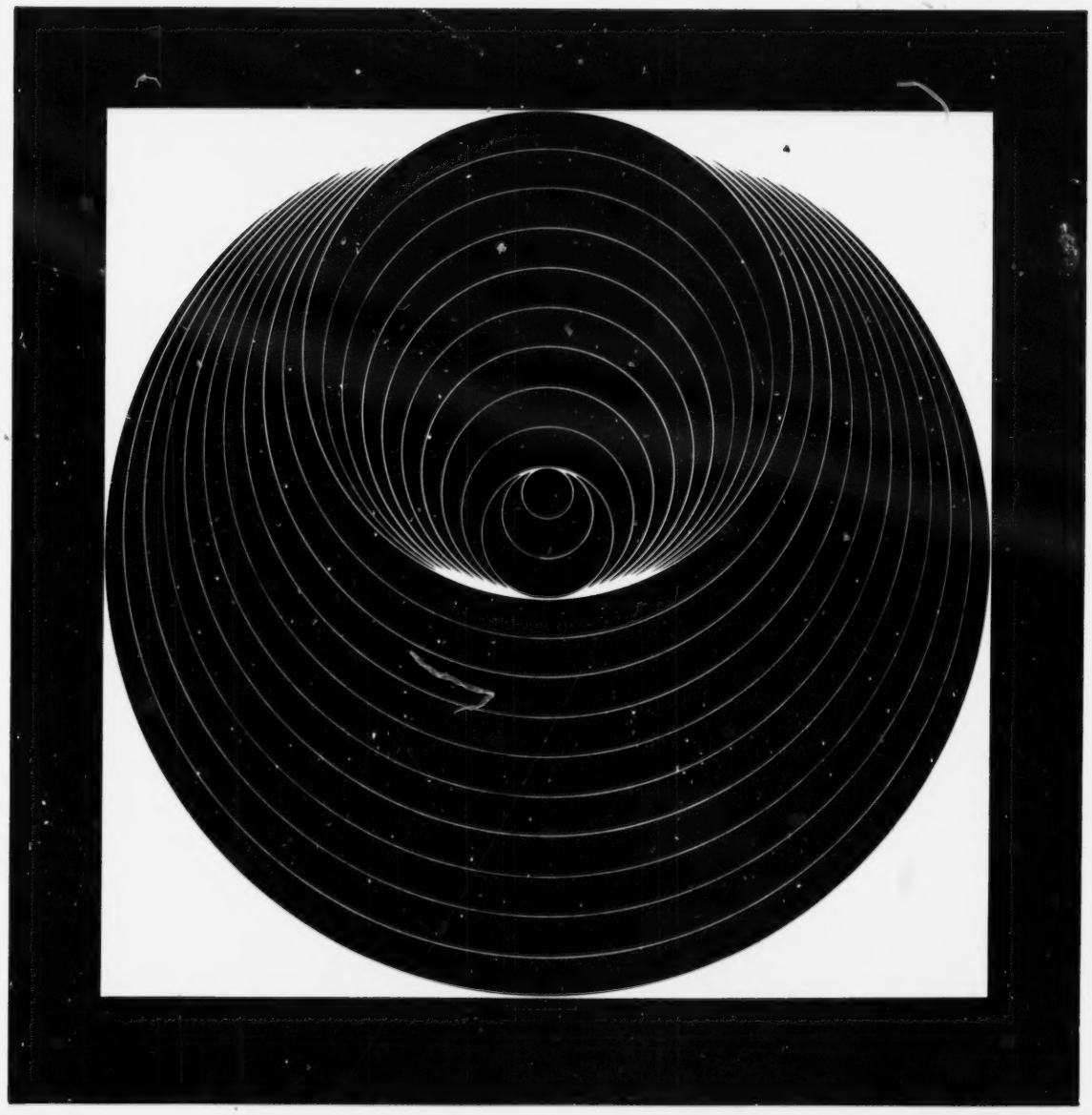
The Relationship of Hearing to Learning

Some Effects of Hearing Impairment Upon School Performance

The Office of the
Superintendent of
Public Instruction
State of Illinois
Ray Page
Superintendent

EC 030 838



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The authors are grateful to the following persons for assistance in various phases of the project: Miss Hazel Bothwell and Mr. J. Thomas Nelson for assistance in initiating the project and obtaining the subjects; Mr. William J. A. Marshall and Mr. Jacobo F. Pino for assistance in the educational and psychological testing; Dr. Darrell E. Rose for his help in arranging for the audiometric testing; and Dr. Philip J. Schmitt for assistance in the analysis of data.

SOME EFFECTS OF HEARING IMPAIRMENT UPON SCHOOL PERFORMANCE

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The Problem and Its Background

The study is concerned with the effects of hearing impairment upon various aspects of school performance in a group of children enrolled in the public schools of Elgin, Illinois in the academic year 1967-1968. The 116 subjects were part of a group of 173 students who had been identified as "hearing impaired" by various screening procedures conducted by school nurses and other personnel at various times. Audiograms were available for all subjects prior to the present study, although many of the audiograms were considered to be of dubious validity, some showed only very mild "hearing impairment" which would ordinarily not be considered as educationally handicapping, and a number reported only unilateral hearing impairment. The major purpose of the study was to determine if the subjects, for whom no special educational provisions had been made, were experiencing any educational difficulties which might be attributed to their "hearing impairment".

Related Studies

The literature contains some references related to the particular concern of the present study. Only three will be cited here to indicate the nature of the problem and its apparent national extent.

Young and McConnell (1957) studied the vocabulary level of 20 children with a mean hearing threshold level of 51 dB averaged at 500-2000 Hz (ASA, 1951) enrolled in regular classes to determine if it differed significantly from that of 20 comparable children with normal hearing. Using verbal and visual presentation of the Ammons Full-Range Picture Vocabulary Test they found a statistically significant difference between the two groups in favor of the children with normal hearing. The difference was not only a group difference, for no hard of hearing child received a higher score on the vocabulary test than did his matched control subject. Furthermore, every hearing impaired child in the study (individual hearing threshold levels ranged from 32 dB to 75 dB) was retarded verbally in comparison to his intellectual potential. Kodman (1963) administered several tests to 100 hearing impaired Kentucky school children. The mean age of the children was 11.1 years; mean IQ, 92.3; mean SRT (speech reception threshold), 40 dB for right and for left ears; mean PB discrimination scores, 81% for right ear and 78% for left ear. When the average grade achievement was computed for the total group on the basis of the Stanford, Metropolitan, or California tests it was found to be 3.84 years. The mean grade placement in the schools was 4.84 years. The "expected" grade placement was also calculated by assuming that the children entered school at age six and passed each grade thereafter. When classified this way, the children had an average expected grade placement of 6.08 years. Kodman also noted that while 65% of the children were possible candidates for a hearing aid only 35% were fitted with hearing aids.

Furthermore, only 24% of the pupils had received lipreading instruction and speech therapy. Gaeth and Lounsbury (1966) reported on the use of hearing aids by 134 hearing impaired children in elementary schools. Interviews, test results, and measurements of acoustic characteristics of aids indicated that no more than 50% of the children were getting adequate hearing by the most lenient standards.

These studies indicate that children with hearing impairment, short of what might be considered deafness, suffer retardation in important educational skills and that the retardation could be directly related to the hearing impairment. A number of possible solutions could be proposed to alleviate this situation. One is that the present numbers of speech and hearing specialists and teachers of the deaf be greatly increased in order to provide services for the hard of hearing child. Another is that different types of services, and perhaps a differently trained type of specialist, need to be supplied for the hard of hearing child. To quote Kodman:

> In the opinion of the author, this gap between educational retardation and the presumed educational potential of these children may in part arise from a general apathy on the part of the public schools and a failure to grapple realistically with the special educational needs of the hard-of-hearing school-age child. It seems unlikely, of course, that improvements of communication skills alone will close the gap completely. This statement does not imply that speech and hearing therapy is not indicated. It seems more appropriate to consider the use of a classroom teacher of the deaf or hard-of-hearing children, along with small-group therapy conducted by speech and hearing clinicians. In the absence of available data, one can merely recommend that a comparative study of these two approaches be made.

In other words, there may exist a group of children, perhaps a very large group, whose educational needs require greater depth and breadth of services than provided usually by the speech and hearing clinician and of a somewhat different type than provided by the teacher

of the deaf in special, usually segregated, programs.

The Problem

In the Spring of 1968, the authors of this paper were requested by the Division of Special Education Services of the Office of the Superintendent of Public Instruction to evaluate the educational performance of a group of hearing impaired children in the public schools of Elgin, Illinois to determine: (1) if the educational performance of the children was commensurate with their educational potential; and (2) the nature and extent of services provided for the subjects.

Procedures

Subjects

The subjects of the study were 116 students, 66 males and 50 females, between the ages of 7 and 17 years who were in grades 2 through 10 in the public schools of Elgin, Illinois in May, 1968. These students were part of a group of 173 who had previously been identified through various procedures in the school system as having hearing impairment but for whom special educational provisions had not been made. The study group of 116 was selected by eliminating from consideration those students who were placed lower than grade two at the time of the study, those who were in classes for the educable mentally handicapped, and those who could not be available for all of the testing sessions. Some students also were excluded from the original group of 173 at their parents' request.

All subjects were tested during the month of May, 1968, in several testing sessions extending over a period of approximately four weeks. Each subject received audiometric evaluation consisting of individual pure frequency bone and air conduction testing; IQ evaluation by group administration of the Chicago Non-Verbal Examination; and partial educational evaluation by administration of the Word Meaning, Paragraph Meaning, and Language subtests of the Stanford Achievement Test, Form W. Data on age, grade placement, and other relevant matters were obtained from school personnel and files. Standard procedures and conditions were followed in the administration of all tests.

Classification of Hearing Threshold Levels

Table 1 shows the classification of hearing threshold levels used by the Department of Public Health and the Office of the Superintendent of Public Instruction of the State of Illinois. This classification was adapted from the classification presented by Davis (1965) and the Subcommittee on Hearing in Adults for the Committee on Conservation of Hearing of the American Academy of Ophthalmology and Otholaryngology. The Illinois classification has been used, with some modifications, in presenting part of the data of the present study. The modifications will be discussed in a later section of the report.

Results

Characteristics of the Study Population

Table 2 presents the frequency distributions, means, and standard deviations of the ages of the students involved in the study.

TABLE II.
Relationship of Degree of Handicap to Educational Needs *

DEGREE OF HANDICAP	EFFECT OF HEARING LOSS ON THE UNDERSTANDING OF LANGUAGE AND SPEECH	EDUCATIONAL NEEDS AND PROGRAMS[3]
SLIGHT 16 to 29dB (ASA) or 27 to 40dB (ISO)	May have difficulty hearing faint or distant speech. Will not usually experience difficulty in school situations.	May benefit from a hearing aid as loss approaches 30dB (ASA) or 40dB (ISO). Attention to vocabulary development. Needs favorable seating and lighting. May need lip reading instruction. May need speech correction.
MILD 30 to 44dB (ASA) or 41 to 55dB (ISO)	Understands conversational speech at a distance of 3–5 feet (face-to-face). May miss as much as 50% of class discussions if voices are faint or not in line of vision. May exhibit limited vocabulary and speech anomalies.	Child should be referred to special education for educational follow-up if such service is available. Individual hearing aid by evaluation and training in its use. Favorable seating and possible special class placement, especially for primary children. Attention to vocabulary and reading. May need lip reading instruction. Speech conservation and correction, if indicated.
MARKED 45 to 59dB (ASA) or 56 to 70dB (ISO)	Conversation must be loud to be understood. Will have increasing difficulty with school situations requiring participation in group discussions. Is likely to have defective speech. Is likely to be deficient in language usage and comprehension. Will have evidence of limited vocabulary.	Will need resource teacher or special class. Special help in language skills, vocabulary development, usage, reading, writing, grammar, etc. Individual hearing aid by evaluation and auditory training. Lip reading instruction. Speech conservation and speech correction. Attention to auditory and visual situations at all times.
SEVERE 60 to 79dB (ASA) or 71 to 90dB (ISO)	May hear loud voices about one foot from the ear. May be able to identify environmental sounds. May be able to discriminate vowels but not all consonants. Speech and language defective and likely to deteriorate. Speech and language will not develop spontaneously if loss is present before one year of age.	Will need full-time special program for deaf children, with emphasis on all language skills, concept development, lip reading and speech. Program needs specialized supervision and comprehensive supporting services.. Individual hearing aid by evaluation. Auditory training on individual and group aids. Part-time in regular classes only as profitable.
EXTREME 80dB or more (ASA) or 91dB or more (ISO)	May hear some loud sounds but is aware of vibrations more than tonal pattern. Relies on vision rather than hearing as primary avenue for communication. Speech and language defective and likely to deteriorate. Speech and language will not develop spontaneously if loss is present before one year.	Will need full-time in special program for deaf children, with emphasis on all language skills, concept development, lip reading and speech. Program needs specialized supervision and comprehensive supporting services. Continuous appraisal of needs in regard to oral and manual communication. Auditory training on group and individual aid. Part-time in regular classes only for carefully selected children.

* Bernero, Raymond J. and Bothwell, Hazel "Relationship of Hearing Impairment to Educational Needs," Illinois Department of Public Health and Office of the Superintendent of Public Instruction, 1966.

Table 2

Ages of Students - Distributions, Means, and Standard Deviations

Ages (Yrs.)	Male		Female		Total	
	No.	%	No.	%	No.	%
7	3	4.5	4	8.0	7	6.0
8	10	15.2	7	14.0	17	14.7
9	4	6.1	9	18.0	13	11.2
10	5	7.6	2	4.0	7	6.0
11	6	9.1	5	10.0	11	9.5
12	7	10.6	7	14.0	14	12.1
13	5	7.6	5	10.0	10	8.6
14	12	18.2	4	8.0	16	13.8
15	10	15.2	7	14.0	17	14.7
16	3	4.5	0	0.0	3	2.6
17	1	1.5	0	0.0	1	0.9
Totals*	66		50		116	
Mean Age	11.89		11.00		11.51	
S.D.	2.79		2.61		2.75	

*Percentages may not total 100 due to rounding

Ages were adjusted to May 1, 1968 for all subjects. The mean age of the total group was 11.51 years with a standard deviation of 2.75 years. The males were slightly older than the females with a mean age of 11.89 years and a standard deviation of 2.79 as compared to 11.00 years and a standard deviation of 2.61. It is of interest to note that the percentages of students are fairly evenly distributed over the age range except for the sharp drop beyond age 15 with only 2.6% (three students) and 0.9% (one student) being in the age categories of 16 years and 17 years, respectively. It should be remembered that the students were not selected by screening the entire school population, but were children who had previously been identified as being hearing impaired through various procedures used in the school system.

Table 3 shows the frequency distributions, means, and standard deviations for the IQ's of the study population. Study of the percentage distribution of the IQ's for the total group will reveal that it follows a normal distribution. The mean IQ of the total group was approximately 102.59, with a standard deviation of 16.89. The mean for the males was approximately seven points higher than for the females.

Table 4 shows the frequency distributions, means, and standard deviations of the hearing threshold levels of the subjects. The classification of hearing threshold levels used here is a modification of the classification in Table 1. One modification made was the elimination of the Severe (71 to 90 dB, ISO) and the Extreme (91 dB or more, ISO) categories. These were eliminated simply because no subjects in the study had hearing impairment of such marked degree. The other modification is of more importance.

Table 3

IQ's of Students - Distributions, Means, and Standard Deviations

IQ	Male		Female		Total	
	No.	%	No.	%	No.	%
50-59	0	0.0	1	2.0	1	0.9
60-69	2	3.0	2	4.0	4	3.4
70-79	0	0.0	3	6.0	3	2.6
80-89	6	9.1	10	20.0	16	13.8
90-99	15	22.7	10	20.0	25	21.6
100-109	19	28.8	8	16.0	27	23.3
110-119	10	15.2	8	16.0	18	15.5
120-129	11	16.7	7	14.0	18	15.5
130-139	2	3.0	1	2.0	3	2.6
140 or more	1	1.5	0	0.0	1	0.9
Totals*	66		50		116	
Mean I.Q.	105.56		98.60		102.56	
S.D.	15.78		17.48		16.89	

*Percentages may not total 100 due to rounding.

This involved the inclusion of the category from Davis (1965) of hearing threshold levels of less than 26 dB ISO. The category was not included in the Illinois adaptation (Table 1) of the Davis classification because hearing threshold levels of this nature were not considered to be educationally handicapping. Examination of the educational performance of the study population revealed that subjects with hearing threshold levels of less than 26 dB did, as a group, have educational performance lower than would be expected in light of their intellectual potential. Also, the majority of subjects had hearing threshold levels in this category (82.7%). Further examination of the data resulted in dividing this category into two parts: less than 15 dB and 15 to 26 dB.

It has been noted that most of the subjects were in the first two categories of Table 4, with 50.8% in the less than 15 dB group and 31.9% in the 15 to 26 dB group. Relatively few subjects were in the other three categories. Again, it should be remembered that the study population consisted of students with identified hearing impairment for whom special class or special school provisions had not been made. The mean hearing threshold level for the total group (better ear average) was 16.84 dB with a standard deviation of 15.28. The worse ear average was 37.75 dB and the standard deviation 28.60. A number of the students had unilateral impairment.

Performance of the Study Population

Table 5 shows the differences between expected grade performance (computed from birthdates of the subjects) and actual

Table 4

Hearing Threshold Levels of Students (ISO) - Distributions, Means, and Standard Deviations

Hearing Threshold Level (Better Ear)	Male No.	Male %	Female No.	Female %	Total No.	Total %
Less than 15 dB	35	53.0	24	48.0	59	50.8
15 to 26 dB	22	33.3	15	30.0	37	31.9
27 to 40 dB	4	6.1	2	4.0	6	5.2
41 to 55 dB	3	4.5	6	12.0	9	7.8
56 to 70 dB	2	3.0	3	6.0	5	4.3
Better Ear Hearing Level (dB)						
Mean		14.52		19.90		16.84
S.D.		13.80		16.55		15.28
Worse Ear Hearing Level (dB)						
Mean		37.29		38.36		37.75
S.D.		30.66		25.60		28.60
Totals*	66		50		116	

*Percentages may not total 100 due to rounding.

Table 5

Differences Between Expected Performance and Actual Performance of the Subjects on Various Subtests of the Standford Achievement Test

Hearing Threshold Level (Better Ear)	N	IQ	Word Meaning	Paragraph Meaning	Language	Subtest Average
Less than 15 dB	59	105.14	-1.04	-0.47	-0.78	-0.73
15 to 26 dB	37	100.81	-1.40	-0.86	-1.16	-1.11
27 to 40 dB	6	103.50	-3.48	-1.78	-1.95	-2.31
41 to 55 dB	9	97.89	-3.84	-2.54	-2.93	-3.08
56 to 70 dB	5	92.40	-2.78	-2.20	-3.52	-2.87
Total Group	116	102.56	-1.66	-0.90	-1.30	-1.25

Expected Grade Placement in School (N = 116)M, 6.90; sd, 2.63.
Actual Grade Placement in School (N = 116)M, 5.78; sd, 2.61.

grade performance for the subjects on several subtests of the Stanford Achievement Test, Form W. Only the Word Meaning, Paragraph Meaning, and Language subtests were administered because the major interest was in the effects of hearing impairment on language development. The results are presented by categories of hearing threshold level with information on the number of subjects and mean IQ also being given for each category.

Two things may be readily noted from study of Table 5. First, for every subtest in every hearing level category actual performance was lower than expected performance. Second, there was a steady progression in retardation on each subtest through the various hearing threshold categories with the exception of the last category where only the Language subtest maintained the progression. The mean difference score for the average of the subtests was -1.25 grades. The expected grade achievement of the subjects (based on birthdate) was 6.90 and the actual grade placement was 5.78 for a difference of -1.12. Thus, the retardation in grade placement was very similar to the retardation in test performance.

The data indicate that the subjects were not achieving in school at a rate commensurate with their educational potential. It is assumed that the retardation was due to hearing impairment. Other factors, of course, might be responsible. One of these is the possibility that educational achievement for the entire school system from which the subjects were drawn was considerably lower than the national norms for the Stanford Achievement Test. In view of the above average socio-economic level of the school system, this seems unlikely. The suspicion that hearing impairment was the causative

factor is supported by the obvious relationship between the degree of hearing impairment and degree of retardation as evident in Table 5 and by the findings of other studies reviewed earlier in the report.

It can be seen from Table 5 that the modified classification used in this study provided differentiation among the various categories of hearing threshold level that are educationally meaningful. This can be seen most clearly in the Language subtest where there was steadily increasing retardation from the least severe to the most severe category. On the Word Meaning and Paragraph Meaning subtests the same progression is evident except for the most severe category where there was a reversal. The reason for the reversal is not apparent although it may have been due to the small number of subjects in the most severe category.

Of particular interest in Table 5 is the educational retardation in the first two categories of hearing threshold level (less than 15 dB and 15 to 26 dB). These categories do not appear in the Illinois classification (Table 1), and they form a single category in the Davis classification which is listed as "not significant" in degree of handicap. The data of the study indicate that children with hearing threshold levels in this category might indeed have some degree of educational handicap. Furthermore, the division of this category of the Davis classification into two parts in the present study seems to be educationally meaningful in terms of academic performance. While Davis cautioned that his classification was for statistical and not educational purposes, the data of the present study indicate that it might serve very well as an educational

classification with the modification suggested. Confirmation of this, however, would require much more extensive research than the present exploratory investigation. It will be remembered that the final two categories of the Davis classification were not included in this study since none of the subjects fell within those categories.

Provision of Services to the Population

The second purpose of the study was to determine what special services were provided for the subjects. Table 6 presents the data relating to this point. Only five of the 116 subjects wore hearing aids. While the complete absence of hearing aids in the first two hearing threshold level categories was to be expected considering the slight degree of impairment, the educational retardation found for subjects in these categories should be borne in mind. Less understandable was the fact that none of the six subjects in the third category (27 to 40 dB), only three of the nine subjects in the fourth category (41 to 55 dB), and only two of the five subjects in the fifth category (56 to 70 dB) wore hearing aids. Unless there were medical or audiological findings to the contrary, it would be expected that children with those degrees of hearing impairment would benefit from amplification. The provision of services other than amplification also was lacking in view of the educational retardation of many of the subjects. Only 31.0% of the subjects received special seating in class, 21.6% were receiving speech therapy, 4.3% had received help from school social workers, and 16.4% received periodic hearing tests.

Table 6.

Amplification and Special Services for Subjects with Various Degrees of Hearing Loss
Hearing Threshold Level (Better Ear)

	Less than 15		15 to 26 dB		27 to 40 dB		41 to 55 dB		56 to 70 dB		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Wears Hearing Aid	0	0.0	0	0.0	0	0.0	3	33.3	2	40.0	5	4.3
Services:												
Special Seating	20	33.9	11	29.7	0	0.0	5	55.6	0	0.0	36	31.0
Speech Therapy	12	20.3	8	21.6	0	0.0	3	33.3	2	40.0	25	21.6
Desk Amplifier	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
School Social Work	2	3.4	3	8.1	0	0.0	0	0.0	0	0.0	5	4.3
Periodic Hearing Tests	11	18.6	4	10.8	0	0.0	4	44.4	0	0.0	19	16.4
Totals*	59		37		6		9		5		116	

*There may be more than one response for each subject.

Discussion

Several points seem obvious from the findings of this study and other studies reviewed in the report. First, it seems probable that even relatively mild levels of hearing impairment might result in educational retardation for at least some children. This would indicate the importance of periodic screening of hearing by qualified personnel for all children in the public school system and the need for provision of appropriate medical and educational services for those with hearing impairment. The need for such screening is also indicated by the fact that the 173 students identified as "hearing impaired" by the screening procedures of the school system represented only 0.009% of the 19,456 children enrolled, a much lower percentage than would be expected. Second, it seems obvious that the "hard of hearing" population is composed of a number of sub-populations which might have differing educational needs. The classification proposed by Davis would seem to provide the basis for educationally meaningful categories for grouping hearing impaired children. Third, the provisions for the hearing impaired subjects in the present study were woefully inadequate. In view of the findings of other studies, it seems likely that such provisions are just as woefully inadequate in most other school systems.

There seems to be a large population of hearing impaired children in the schools whose needs are not being met by the services now provided. If a child has hearing impairment of sufficient severity to be considered "deaf", there usually are special services available for his education. If he has a relatively mild impairment,

the services of the speech and hearing specialist might prove sufficient where these are available and adequate. There likely is, however, a large group of hearing impaired children for whom neither of these types of services will suffice. These children do not require the very long term, relatively segregated educational programs of the "deaf" child. Yet they require longer term and more intensive services in language and general educational development than can be provided by speech and hearing specialists.

Two professional organizations have expressed some concern recently about the possible plight of the hard of hearing child. The Joint Committee on Audiology and Education of the Deaf, composed of members from the American Speech and Hearing Association and from the Conference of Executives of American Schools for the Deaf, has undertaken a national survey of the provisions being made in the schools for this type of child. Hopefully, the data resulting from this survey will clarify the needs of the hard of hearing child, detail the provisions now being made for him in the schools, and lead to improved services if this proves to be necessary. The recently established American Organization for the Education of the Hearing Impaired has indicated that it will be interested in hearing impairment at all levels and "hopes to develop terminology that reflects the nature of hearing impairment more accurately, hopefully leading to improvement in educational placement and treatment." (Calvert, 1968). This welcome interest in the whole continuum of hearing impairment on the part of the AOEHI might lead to greater professional concern for the educational needs of the hard of hearing child.

A few cautionary remarks are in order concerning the present study. The findings should be considered as tentative and generalizations should be made with extreme caution, if at all. The group of students studied represented an accidental sampling. That is, they had been identified by the school system in an unsystematic way as probably being hearing impaired. The investigators merely studied a subgroup of these subjects (116 out of 173) and tried to determine if they were indeed hearing impaired and if they had any educational problems which might be related to their hearing impairment. The results, and the findings of other studies which were reviewed, indicate that even mild hearing impairment might result in educational problems for many children. The identification and treatment, medical and educational, of hard of hearing children could well be one of the most neglected problems in the public schools.

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